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شرکت ملی گاز ایران  
مدیریت پژوهش و فناوری  
امور تدوین استانداردها

# IGS

دستورالعمل

سیستم پوششی اپوکسی پودری برای سطوح خارجی خطوط لوله گاز طبیعی

Plant Applied External Fusion Bond Epoxy Coating System  
for Line Pipe



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شرکت ملی گاز ایران



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## ابلاغ مصوبه هیأت مدیره

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باسلام،

به استحضار می‌رساند در جلسه ۱۸۹۰ مورخ ۱۳۹۹/۰۶/۲۳ هیأت مدیره، نامه شماره گ/۰۰۰/۹/۶۹۴۵۸ مورخ ۱۳۹۹/۰۶/۱۶ آن مدیریت در مورد تصویب نهایی مقررات فنی شرکت ملی گاز ایران به شرح زیر مطرح و مورد تصویب قرار گرفت.

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این مصوبه در حکم مصوبه مجمع عمومی شرکت های تابعه محسوب و برای کلیه شرکت های تابعه لازم الاجرا می باشد.

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## Foreword

This technical specification is intended to be mainly used by N.I.G.C. and contractors, and has been prepared base on interpretation of recognized standards and technical documents, as well as knowledge, backgrounds and experiences in gas industries at national and international levels.

Iranian Gas Specification (IGS) are prepared, reviewed and amended by technical standard committees within NIGC standardization division of research and technology management and submitted to "the standards council of NIGC" for approval.

IGSs are subjected to revision, amendment or withdrawal, if required, and thus the latest edition of IGS shall be checked / inquired by NIGC'S users.

This specification must not be modified or altered by NIGC employees or its contractors. Any deviation or conflicts between this specification and other applicable standards, codes, procedure or well-known manufacturer's specifications must be resolved in writing by the user or its representative through Manager, Engineering Department or standardization division of NIGC.

The technical standard committee welcomes comments and feedbacks from concerned or interested corporate and individuals about this standard, and may revise this document accordingly based on the received feedbacks.

## General Definitions

Throughout this specification the following definitions, where applicable, should be followed:

- 1- "STANDARDIZATION DIV." is organized to deal with all aspects of industry standards in NIGC. Therefore, all enquiries for clarification or amendments are requested to be directed to mentioned division.
- 2- "COMPANY": refers to National Iranian Gas Company (NIGC).
- 3- "SUPPLIER": refers to a firm who will supply the service, equipment or material to IGS specification whether as the prime producer or manufacturer or a trading firm.
- 4- "SHALL ": is used where a provision is mandatory.
- 5- "SHOULD": is used where a provision is advised only.
- 6- "MAY": is used where a provision is completely discretionary.

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## Guidance for use of this specification

The amendments/ supplements CSA Z245.20 SERIES 2018 given in this Specifications are directly equivalent sections or clauses in CSA Z245.20. All other Paragraphs which are not amended by this supplementary shall remain valid as Written. The following annotations, as specified hereunder, have been used at the Beginning of each paragraph to indicate the type of change made to that paragraph of CSA Z245.20.

**Sub.** (Substitution) "The paragraph in CSA Z245.20 shall be deleted and replaced By the new paragraph in this supplementary"

**Del.** (Deletion) "The paragraph in CSA Z245.20 shall be deleted without any Replacement"

**Add.** (Addition) "The new paragraph with the new number shall be added to The relevant section of CSA Z245.20"

**Mod.** (Modification) "Part of the clause or paragraph in CSA Z245.20 shall be modified and/or the new description and/or statement shall be added to that clause or paragraph as given in this supplementary.

## 1. Scope (mod.)

This Specification covers the qualification, application, inspection, testing, handling, and storage of materials required for plant-applied fusion bond epoxy (FBE) coating applied externally to bare steel pipe. The coated pipe is intended primarily for buried or submerged service for gas pipeline systems.

### 1.2(Sub.)

This Specification covers the following coating systems:

- a) **System 2A:** two-layer FBE with an anti-corrosion coating and a protective overcoat;
- b) **System 2B:** two-layer FBE with an anti-corrosion coating and an abrasion-resistant overcoat;
- c) **System 2C:** two-layer FBE with an anti-corrosion coating and an anti-slip overcoat; and
- d) **System 3:** three-layer FBE with an anti-slip or an abrasion-resistant or an anti UV or a watertight overcoat applied over an anti-corrosion coating and a protective overcoat.

**NOTE 1:** Material, properties, composition and additional new layers shall be chosen by designer of client.

**NOTE 2:** The FBE powders (first and second layers of the coating system) shall be supplied by the same manufacturer and shall have a proven track record in pipeline coating applications.

**NOTE 3:** If the FBE coating is selected for pipeline field joints or fittings, the requirement of this standard shall be met.

## 2. References (add.)

**CSA Z245.20 (2018)** "Standard for External Fusion Bond Epoxy Coating for Steel Pipe"

**IGS-M-PL-001-2(1) (2016)** "SMLS/HFW/SAWL/SAWH Carbon Steel Pipes, Grades B to X80, Sizes: 6 to 56 inch.

**ISO 8501-1 (1994)** "Preparation of Steel Substrates before Application of Paints and Related Products – Visual Assessment of Surface Cleanliness – Part1: Rust Grades and Preparation Grades of Uncoated Steel Substrates after Overall Removal of Previous Coatings"

**ISO 8502-6 (2000)** " Preparation of Steel Substrates before Application of Paints and Related Products – Test for the Assessment of Surface Cleanliness – Part 6: Extraction of Soluble Contaminants for Analysis – The Bresle Method"

**ISO 8502-9 (2001)** "Preparation of Steel Substrates before Application of Paints and Related Products – Test for the Assessment of Surface Cleanliness – Part 9: Field Method for the Conduct Metric Determination of Water-Soluble Salts"

**ISO/TS 29001 (2010)** "Petroleum, petrochemical and natural gas industries – Sector-specific quality management systems – Requirements for product and service supply organizations"

**ASTM D4940 (2015)** "Standard test method for conduct metric analysis of water soluble ionic contamination of blasting abrasives"

**IGS-M-PL-001(0) (2014)** "Loading, Handling and Storage of Externally Coated Pipes  
ISO 4624 (2016) "Paints and varnishes — Pull off test for adhesion.

### 3. Definitions

(Del.) Vehicle shipment of epoxy powder — an individual container received at the site of the applicator with a total weight of epoxy powder not to exceed 25 000 kg

## 4. General Requirements

### 4.1.1 Standard requirements(sub.) (a,c )

- a) IGS standard designation and year of publication (IGS-M-TP-026);
- c) Coating system (2A, 2B, 2C, or 3; see Clause 1.2);

### 4.3 Requirements for quality (sub.)

The applicator shall comply with the requirements of ISO /TS29001.

## 5. Materials

### 5.2 Epoxy powders

#### (mod.) 5.2.2 Properties

The epoxy powder properties shall be in accordance with the requirements of Table 5 for Systems 2A, 2B, 2C, and 3. The epoxy powder manufacturer shall conduct tests for each epoxy powder type and provide the applicator with a test report of the epoxy powder properties specified in Table 5 for Systems 2A, 2B, 2C, and 3. The date of the tests performed by the epoxy powder manufacturer for the epoxy powder being applied shall not be more than 365 days prior to the date of application of the coating by the applicator. This certification shall be supplied with each batch of materials.

## 6. Coating application

### 6.1.2.2 (mod.)

The surface shall be blast cleaned using an acceptable steel grit in accordance with SSPC SP 5/NACE No. 1 or SA 3 according to ISO 8501-1. The surface profile, measured from peak to trough, shall be 40 to 110 µm.

### 6.1.3 Coating qualification test requirements (mod.)

Systems 2A, 2B, 2C, and 3 shall be evaluated in accordance with Table 6. The tests to be conducted, the number of test specimens, the test methods to be used, and the acceptance criteria shall be as specified in Tables 6. The epoxy powder manufacturer shall conduct tests and provide the applicator with a test report for the coating properties specified in Table 6 for Systems 2A, 2B, 2C, and 3. The anti-corrosion coating shall be qualified in accordance with the requirements of Table 2 for Systems 2A,2B, 2C, and 3. The date of the tests performed by the epoxy powder manufacturer for the epoxy powder

being applied shall not be more than 365 days prior to the date of application of the coating by the applicator.

## **6.2 Production application practices and equipment**

### **6.2.2.3 (mod.)**

Except where allowed by Clause 6.2.2.5, the external pipe surface to be coated shall be blast cleaned to at least SSPC SP 5/NACE No. 1 specifications or SA 3 according to ISO 8501-1. The surface profile, measured from peak to trough, shall be 40 to 110  $\mu\text{m}$  and in accordance with the powder manufacturer's recommendations.

### **6.2.2.5 (Sub.)**

#### **Notes:**

2) Surface defects include, but are not limited to, gouges, grooves, arc burns, dents, and surface laminations. See Clause 6.3, IGS-M-PL-001-2(1) for more information on pipe surface requirements applicable to steel piping.

### **6.2.2.6**

#### **6.2.2.6.1 (Add.)**

The phosphoric acid wash shall be used as a surface treatment after all surface preparation operations and just prior to heating for coating application. The phosphoric acid treatment shall be applied at an acid concentration of 10 % by volume  $\pm$  3%. the concentration shall be measured using a titration method recommended by the manufacturer. Pipe temperature shall be uniformly at 45°C to 65°C for treatment within the maximum elapsed time after blast cleaning. The phosphoric acid solution shall be uniformly applied to the pipe surface with a low pressure (0.5 – 2.0 bar) spray application and shall remain on the surface in accordance with the manufacturer's recommendations. Pipe surfaces shall remain wet at all times during the phosphoric acid treatment. Any treated pipe shall be re blasted if the acid solution is allowed to dry anywhere on the surface of that pipe. A uniform PH of 1 or less shall be maintained over the entire surface of treated area. The acid washed pipe surface shall remain wetted for 10 to 30 seconds. After the dwell time, the pipe surface shall be thoroughly rinsed with high pressure clean water before it starts to dry out. High-pressure rinse water used shall be at 700 – 1000 psi (50 – 70 bar) to remove any treatment residue. The water used shall meet the following requirements:

Chlorides shall not exceed 10 ppm, sulfates shall not exceed 40 ppm, and nitrates shall not exceed 10 ppm. The total of these salts shall not exceed 60 ppm. the water shall not be reused. The max. conductivity of water is 60  $\mu\text{S}/\text{cm}$  in accordance with ASTM D4940.

The minimum pH of the wet surface after rinsing shall be 6.0, as determined by touching pH paper directly to the pipe surface. The pH paper shall have a measurement increment of 0.5 pH units or less. The appearance of the pipe surface after drying shall be substantially the same as it was immediately after blast cleaning. Occasional watermarks are permitted. The maximum allowable residual soluble salts (chloride contamination) level on the surface shall be 20  $\text{mg}/\text{m}^2$  in accordance with ISO 8502-6 or ISO 8502-9 (SCM400/ Elcometer 130 tests).



### **6.2.5 (sub.)**

The coating shall be applied to the external surface of the full length of each pipe except for a cutback of  $100 \pm 7$  mm for pipe diameter up to 20" and  $150 \pm 10$  mm for equal or greater than 20" at each end. The cutback shall be measured from the bevel shoulder. Any coating applied to the cutback shall be removed.

There shall be no change in the cutback length without approval of the purchaser.

## **7. Inspection and Testing**

### **7.3.1 Epoxy powder and coating**

#### **7.3.1.1 (mod.)**

The applicator shall conduct the sample preparation, testing, and evaluation of the epoxy powder and coating in accordance with the requirements of Tables 7 and 8 for Systems 2A, 2B, 2C, and 3. Tests shall be done at the application facility unless otherwise agreed by the purchaser.

#### **7.3.1.4 (mod.)**

Prior to the use of the powder for production coating, laboratory-coated test specimens shall be prepared by the applicator at the proposed plant application temperature in accordance with the requirements of Clause 6.1.2. The tests to be conducted, the number of test specimens to be used, the test methods to be used, and the acceptance criteria shall be as specified in Table 7 for Systems 2A, 2B, 2C, and 3. Where a test from Table 7 fails to conform to the specified requirements, the applicator shall have the option of repeating that specific test using two additional samples taken from the batch. Where both retests conform to the specified test requirements, the powder batch shall be accepted. Where one or both retests fail to conform to the specified requirements, the powder batch shall be rejected. The applicator shall test another batch or test each batch to qualify the vehicle shipment or reject the vehicle shipment.

#### **7.3.2.7.3 (del.)**

#### **7.3.2.7.5 (del.)**

### **7.3.2.8 Holiday inspection**

#### **7.3.2.8.2 Acceptance criteria**

##### **7.3.2.8.2.4 (Add)**

Coated pipe having holidays shall be repaired by patching in accordance with the requirements of Clause 8.2, provided that the number of holidays does not exceed the following:

(a) for pipe smaller than 355.6 mm OD: 1.0 per meter, determined by dividing the total number of holidays by the total pipe length for the individual pipe tested; or

(b) for pipe 355.6 mm OD or larger: 0.7 per square meter, determined by dividing the total number of holidays by the total outside surface area for the individual pipe tested.

### 7.3.3.2 Test rings (mod.)

Test rings for Systems 2A, 2B, 2C, and 3 shall be no more than 800 mm long. The rings shall be obtained from locations at least 300 mm from a pipe end. Removal of pipe exceeding the specified lengths for test rings shall be by agreement between the applicator and the purchaser. For each test ring, the tests to be conducted, the number of test specimens to be used, the test method to be used, and the acceptance criteria shall be as specified in Table 8. Systems 2A, 2B, 2C, and 3 shall be evaluated in accordance with Table 8.

### 7.3.3.4 Retests — Type A test failures

#### 7.3.3.4.1 (mod.)

Where a Type A test fails to conform to the specified requirements (see Tables 8),

a) the test that failed shall be repeated using two additional test samples (see Clause 7.3.3.2) taken from the originally tested end of the affected pipe; or

b) all pipe coated after the previous acceptable test and prior to the next acceptable test shall be stripped and recoated in accordance with the requirements of Clause 8.3.

### 7.3.3.5 Retests — Type B test failures (Mod.)

Where a Type B test (see 8) fails to conform to the specified requirements, the application process parameters shall be adjusted, and where required by the purchaser, the applicator shall limit the application process until the cause of the failure has been remedied.

**Note:** The process parameters need not be adjusted in those instances where inaccurate interface contamination and interface porosity test results have resulted due to the influence of the particular pretreatment used on the surface of the pipe prior to powder application.

## 8. Repair of Coated Pipe

### 8.2 Holiday repairs (see Table 9) (add.)

Heat shrinkable sleeves are not considered an acceptable repair.

## 9. Markings

### 9.1 General

**Note:** (del.)

### 9.2 Required markings

#### 9.2.1(sub.)

The following markings shall be placed on the coating

- a) applicator's name or mark;
- b) IGS Standard designation and year of publication (IGS-M-TP-026(1));
- c) date of coating application;
- d) coating system (2A, 2B, 2C, or 3);
- e) Nominal coating thickness, in micrometers;
- f) Coating brand identification;
- g) Pipe specification and steel grade;

## **10. Handling and Storage**

### **10.1.6 (add.)**

Coated pipe shall be Loaded, Handled and Storage in accordance with requirement of IGS-M-PL-001(0).

### **10.2 Storage (sub.)**

Separation between coated pipe joints in a stack shall be provided by use of PE rope /PE separators securely attached to the pipe. The rope separators shall be placed nominally at 1.5 m for each pipe end and at nominally 3 m spacing along the pipe length. The diameter of the rope separator shall not be less than 19 mm for pipe of diameter up to and including 324 mm (12 inches) nominal and 25 mm for larger diameter pipe.

<b>Table 1</b>		
<b>Epoxy powder properties for Systems 1A and 1B</b>		
(See Clauses 5.2.2, 7.3.1.3, 12.3, and 12.4.)		
<b>Test</b>	<b>Acceptance criteria</b>	<b>Test method</b>
Cure time	Meets manufacturer's specification	Clause 12.1
Gel time	Within 20% of manufacturer's specified nominal	Clause 12.2
Moisture content*	0.5% maximum	Clause 12.3
	0.6% maximum	Clause 12.4
Particle size	3.0% maximum powder retained on 150 $\mu\text{m}$ mesh and 0.2% maximum powder retained on 250 $\mu\text{m}$ mesh	Clause 12.5
Density	Meets manufacturer's specification within 50 g/L	Clause 12.6
Thermal characteristics	Meets manufacturer's specification	Clause 12.7
* The specific test method to be used shall be at the manufacturer's option.		

**NOTE:**

Table 3 (del.)

Table 4 (del.)

Table 2(sub.)

**Qualification test requirements for anti-corrosion coatings**

(See Clauses 6.1.3, 12.8.3.2, 12.11.3, and 12.14.3.)

TEST	Acceptance criteria	Number of Test specimens	Test method
	System 1A		
Thermal characteristics	Meets manufacturer's specification	3	Clause 12.7
Cure — $\Delta T_g$	$\leq 5$ °C	3	Clause 12.7
24 h cathodic disbondment at 65 °C	5 mm maximum radius	3	Clause 12.8
28 d cathodic disbondment at 20 °C	8 mm maximum radius	3	Clause 12.8
28 d cathodic disbondment at 80 °C	10 mm maximum radius	3	Clause 12.8
Cross-section porosity	Rating of 1–2	3	Clause 12.10
Interface porosity	Rating of 1–2	3	Clause 12.10
3.0° flexibility	No cracking	5	Clause 12.11
1.5 J impact resistance	No holidays	3	Clause 12.12
2.5° strained coating, 28 d cathodic disbondment at 20 °C	No cracking	3	Clause 12.13
24 h adhesion at 75 °C	Rating of 1–2	3	Clause 12.14
28 d adhesion at 75 °C	Rating of 1–3	3	Clause 12.14
Dry adhesion at 20 °C	10N/mm <sup>2</sup> & more than of 75% surface area shall be cohesive	3	ISO 4624
Gouge resistance test,	Max. 250 $\mu$ m Gouge depth	2	Clause 12.15

<b>Table 5</b>		
<b>Epoxy powder properties for Systems 2A, 2B, 2C, and 3</b>		
(See Clauses 5.2.2 and 7.3.1.3.)		
<b>Test</b>	<b>Acceptance criteria</b>	<b>Test method</b>
Cure time	Meets manufacturer's specification	Clause 12.1
Gel time	Meets manufacturer's specification	Clause 12.2
Moisture content*	Meets manufacturer's specification	Clauses 12.3 and 12.4
Particle size	Meets manufacturer's specification	Clause 12.5
Density	Meets manufacturer's specification within 50 g/L	Clause 12.6
Thermal characteristics	Meets manufacturer's specification	Clause 12.7
* The specific test method to be used shall be at the manufacturer's option		

<b>Table 6(sub.)</b>			
<b>Qualification test requirement for systems 2A, 2B, 2C, and 3</b>			
(See Clauses 5.2.2 and 7.3.1.3.)			
<b>Test</b>	<b>Acceptance criteria</b>	<b>Number of test specimens</b>	<b>Test method</b>
Thermal characteristics	Meets manufacturer's specification	3	Clause 12.7
Cure — $\Delta Tg^*$	$\leq 5^\circ\text{C}$	3	Clause 12.7
Cross-section porosity†	Rating of 1–2	3	Clause 12.10
Interface porosity*	Rating of 1–2	3	Clause 12.10
2.0° flexibility	No cracking	5	Clause 12.11
3.0 J impact resistance‡	No holidays	3	Clause 12.12
1.5° strained coating, 28 d cathodic disbondment at 20 °C	No cracking	3	Clause 12.13
Surface roughness§	> 50 $\mu\text{m}$ peak to trough	3	Clause 12.16
Gouge resistance test,	Max. 250 $\mu\text{m}$ Gouge depth	2	Clause 12.15
* Cure and interface porosity tests are to be completed on inner layer of coating system.			
† For individual layers of multi-layer coating systems except anti-slip overcoat.			
‡ For all multi-layer coatings, except for anti-corrosion coating with anti-slip overcoat, use 1.5 J.			
§ Surface roughness for anti-slip overcoat systems only.			

<b>Table 7(sub.)</b>			
<b>Laboratory coating test requirement for systems 2A, 2B, 2C, and 3</b>			
(See Clauses <a href="#">7.3.1.1</a> , <a href="#">7.3.1.4</a> , <a href="#">12.8.3.2</a> , <a href="#">12.11.3</a> , and <a href="#">12.14.3</a> .)			
<b>Test</b>	<b>Acceptance criteria</b>	<b>Number of test specimens</b>	<b>Test method</b>
Cure — $\Delta Tg^*$	$\leq 5\text{ }^\circ\text{C}$	1	Clause <a href="#">12.7</a>
24 h cathodic disbondment at $65\text{ }^\circ\text{C}$	5 mm maximum radius	1	Clause <a href="#">12.8</a>
Cross-section porosity†	Rating of 1-2	1	Clause <a href="#">12.10</a>
Interface porosity*	Rating of 1-2	1	Clause <a href="#">12.10</a>
$1.5^\circ$ flexibility	No cracking	3	Clause <a href="#">12.11</a>
24 h adhesion at $75\text{ }^\circ\text{C}$	Rating of 1–2	1	Clause <a href="#">12.14</a>
Dry adhesion at $20\text{ }^\circ\text{C}$	10N/mm <sup>2</sup> & more than of 75% surface area shall be cohesive	1	ISO 4624
3.0 J impact resistance‡	No holidays	1	Clause <a href="#">12.12</a>
Surface roughness $\mu$	> 50 $\mu\text{m}$ peak to trough	1	Clause <a href="#">12.16</a>
Gouge resistance test,	Max. 250 $\mu\text{m}$ Gouge depth	2	Clause <a href="#">12.15</a>
* Cure and interface porosity tests are to be completed on inner layer of coating system.			
† For individual layers of multi-layer coating systems except anti-slip overcoat			
‡ For all multi-layer coatings, except for anti-corrosion coating with anti-slip overcoat, use 1.5 J.			



**Table 8(sub.)****Production coating test requirement for systems 2A, 2B, 2C, and 3**(See Clauses [7.3.1.1](#), [7.3.3.1](#), [7.3.3.3.3](#), [7.3.3.4.1](#), [7.3.3.5](#), [12.8.3.2](#), [12.11.3](#), and [12.14.3](#).)

Test	Test type	Acceptance criteria	Number of test specimens	Test method
Cure — $\Delta Tg^*$	B	$\leq 5\text{ }^\circ\text{C}$	1	Clause <a href="#">12.7</a>
24 h cathodic disbondment at $65\text{ }^\circ\text{C}$	A	5 mm maximum radius	1	Clause <a href="#">12.8</a>
Interface contamination	B	30% maximum	1	Clause <a href="#">12.9</a>
Cross-section porosity†	B	Rating of 1-2	1	Clause <a href="#">12.10</a>
Interface porosity*	B	Rating of 1-2	1	Clause <a href="#">12.10</a>
$1.5^\circ$ flexibility	A	No cracking	3	Clause <a href="#">12.11</a>
3.0 J impact resistance‡	A	No holidays	1	Clause <a href="#">12.12</a>
24 h adhesion at $75\text{ }^\circ\text{C}$	A	Rating of 1–3	1	Clause <a href="#">12.14</a>
Dry adhesion at $20\text{ }^\circ\text{C}$	-	10N/mm <sup>2</sup> & more than of 75% surface area shall be cohesive	1	ISO 4624
Surface roughness§	B	> 50 $\mu\text{m}$ peak to trough	1	Clause <a href="#">12.16</a>
Gouge resistance test,	-	Max. 250 $\mu\text{m}$ Gouge depth	2	Clause <a href="#">12.15</a>

\* Cure and interface porosity tests are to be completed on inner layer of coating system.

† For individual layers of multi-layer coating systems except anti-slip overcoat

‡ For all multi-layer coatings, except for anti-corrosion coating with anti-slip overcoat, use 1.5 J.

§ Surface roughness for anti-slip overcoat systems only.

<b>Table 9</b>					
<b>Fusion bond epoxy coating repair criteria</b>					
(see clauses <a href="#">7.3.2.8.2.2</a> , <a href="#">7.3.2.8.2.3</a> , <a href="#">8.2</a> , and <a href="#">8.3</a> )					
Pipe outside diameter, mm	Acceptance criteria, repair frequency, max area (individual holiday)	Holiday repair Clause <a href="#">8.2</a>	Strip and recoat Clause <a href="#">8.3</a>	Epoxy repair melt stick or two-part liquid epoxy	Liquid epoxy
< 355.6	$\leq 1.0/m$ and < 250 cm <sup>2</sup>	X		$\leq 2.0$ mm diameter or width	> 2.0 mm diameter or width, and < 250 cm <sup>2</sup>
< 355.6	> 1.0/m or $\geq 250$ cm <sup>2</sup>		X	N/A	N/A
$\geq 355.6$	$\leq 0.7/m^2$ and < 250 cm <sup>2</sup>	X		$\leq 2.0$ mm diameter or width	> 2.0 mm diameter or width, and < 250 cm <sup>2</sup>
$\geq 355.6$	> 0.7/m <sup>2</sup> or $\geq 250$ cm <sup>2</sup>		X	N/A	N/A